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A MARKET RESEARCH STUDY FOR FUTURE WEATHER INFORMATION SYSTEMS IN GENERAL AVIATION

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Abstract
NASA's Aviation Safety Program involves investigation of the feasibility of advanced aviation weather information systems to reduce accident rates. Under this program, integrating weather information systems into the cockpit for General Aviation aircraft is being considered. A market research study was needed to identify the match of technologies and features for a successful cockpit weather system in this market. For this reason, a survey was conducted at the Experimental Aircraft Association (EAA) Convention in Oshkosh, Wisconsin, with General Aviation pilots as participants. This study analyzes the results of this survey and identifies the desired characteristics of the future weather information systems.

Introduction

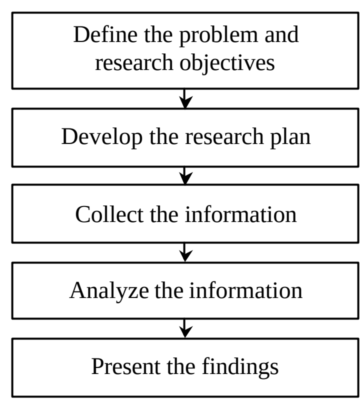
The goal of the NASA Aviation Safety Program (AvSP) is to develop and demonstrate technologies that contribute to a reduction in the aviation fatal accident rate by a factor of 5 by year 2007 and by a factor of 10 by year 2022 (Huettner, 1997). The ambitious program is a partnership that includes NASA, the Federal Aviation Administration (FAA), the aviation industry and the Department of Defense. NASA Langley Research Center in Hampton, VA, is leading the safety program. The Aviation Weather Information (AWIN) project is a sub-group under this program, and works on weather issues. The goal of the AWIN program is to provide improved weather information to users in the National Airspace System, and to foster the improved usage of this information by applying information technology to build a safer aviation system to support pilots (Stough, 1998). Integrating weather information systems into the cockpit for General Aviation (GA) is viewed as an important goal for AWIN. This requires research on new information technologies that provide improved weather information systems into the GA cockpit.

In order to determine the likelihood of market acceptance (feasibility) of these new systems, it is necessary to identify the user requirements and the costs they are willing to pay for their needs to be met. A market research study was needed to identify the match of technologies and features for a successful cockpit weather system in the GA market. For this reason, a survey was conducted at the Experimental Aircraft Association (EAA) Convention in Oshkosh, Wisconsin, which includes inputs from 139 GA pilots. This study analyzes the results of this survey and identifies the desired characteristics of the future weather information systems in GA market.

Methodology

Identification of a feasible product is the pivotal step in product development (Kauffmann, 1997), and effective product development must be market driven (Roussell, 1991, Matheson, 1994, Ransley et al., 1994). In advanced technology planning, market analysis is even more critical since considerable resources and time can be wasted. In this study, the five marketing research process steps presented in Exhibit 1 are followed (Kotler, 2000).

Exhibit 1. Marketing research process.



The problem was defined as determination of market acceptance of future weather information systems in GA market. The research objective is to identify the desired characteristics of these systems. Survey research was selected as the plan since surveys are best suited for descriptive research and allowed inexpensive access to a large market group (Kotler, 2000). Marketing plans are becoming more customer-oriented, better reasoned and more realistic than in the past, and survey research provides direct customer input. Data from the GA pilots was gathered by means of questionnaires prepared by the research team, based on previous research on weather information systems in GA and possible future developments in this area. Future product features presented in the survey were determined according to this information. This study analyzes the data obtained from the participants, and presents the initial findings.

Survey Results

The survey was conducted at the Experimental Aircraft Association (EAA) Convention in Oshkosh, Wisconsin, between July 26 and August 1, 2000. EAA is an organization of members with a wide range of aviation interests and backgrounds. Among its members, there are a large number of pilots (from recreational to commercial), who fly a wide range of different aircraft. Survey questionnaires were taken to the convention and presented to pilots only, to be filled out. There were 139 total participants, with 6 recreational, 58 private, 14 instrument rated, 28 commercial, and 12 air transport pilots. The remaining 21 did not specify a particular pilot category.

The survey questions were selected based on current research on existing weather information systems in the GA market. Also, questions addressed possible information system developments identified during additional research on parallel technologies used in the automotive and trucking industry (Sireli et al., 2001).

The survey consisted of five main sections with several feature options in each. These sections requested data about existing weather information systems that participants currently have, difficulties in using current systems, desired weather information update frequencies, features participants would like to have in the future, and costs that they are willing to pay to have these future systems. Most of the options require the usage of 1 – 5 scale to determine the level of preference or importance, 1 being least preferred or important, 5 being most preferred or important. The results of the main sections of the survey are summarized in the following subsections.

Current weather information systems. Pilots were asked the questions below regarding current equipment in use, and common problems with these systems:

- Describe your current communication method to obtain weather information during flight.
- What are the difficulties in using your weather - related equipment (please note all that apply)? How critical are they? (Please use 1 to 5 scale, 5 being most critical, 1 being least critical).
- How often do you currently get in - flight weather updates and how often would you like them in the future?

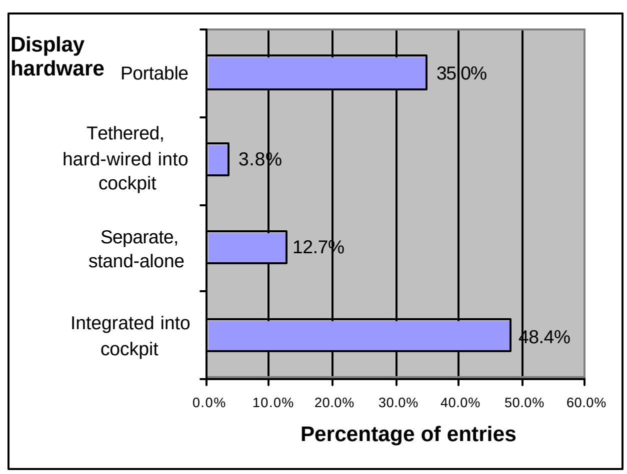
Exhibit 2 summarizes the results of this section.

Exhibit 2. Summary of current weather information systems.

	Current information	**Percentage of entries**
Current communication method (Total entries: 157)	Radio	78.4%
	Other (Airborne Cellular, ground based VHF, satellite LEO/MEO, satellite geo-synchronous)	21.6%
Most important difficulties in using current system (Total entries: 168)	Communication loss	28.6%
	Busy channel	17.3%
	Lack of clarity	35.1%
	Incorrect weather information	19%
Current weather update frequency (Total entries: 102)	Less than 15 minutes	32.3%
	More than 15 minutes up to 4 hours	67.7%
Desired weather update frequency	Less than 5 minutes	93%

Weather information display hardware. In this section, pilots were asked to describe the weather information display hardware they desire in the future. Exhibit 3 summarizes the results of this section.

Exhibit 3. Desired future display hardware.



Preferred features in the future equipment. The question asked in this part of the survey is as follows:

- What features would you like to have on your future system (please note all that apply)? How critical are they? (Please use 1 to 5 scale, 5 being most preferred, 1 being least preferred).

This section consists of six subsections: messaging, geographical data, display, pilot data entry to the system, combined weather-related information, and non-weather services.

The messaging part includes three options: text messages, graphical data, and two-way communication with the ground service provider.

Geographical data includes three options: text GPS, moving map GPS, and 3-dimensional terrain visualization.

Display includes four options: monochrome, color display, LCD, and CRT.

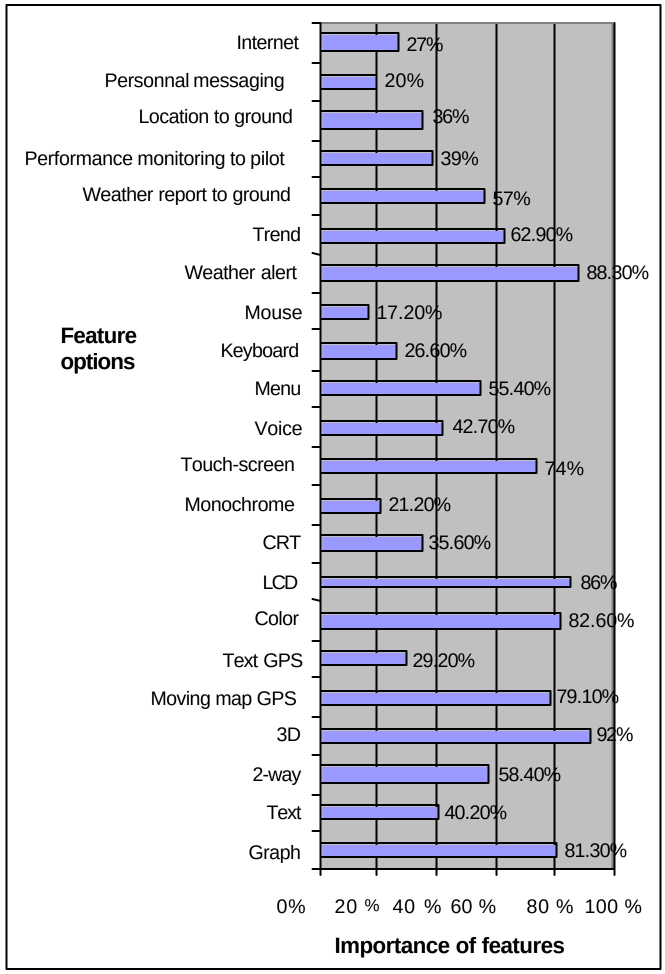
Pilot data entry includes five options: touch-screen, voice recognition, keyboard, mouse, and menu driven with limited keypad.

Combined weather-related information part includes three options: weather alert system about the conditions ahead, trend data from past weather conditions, and weather situation reporting to the ground.

Non-weather services part includes four options: aircraft performance report to the pilot, aircraft location information to the ground, personal messaging, and Internet access.

Exhibit 4 summarizes the results of this section.

Exhibit 4. Preferred features in the future equipment.



Non-recurring costs. Pilots were asked how much they are willing to pay as the non-recurring costs for the future system they described. The results of this part are summarized in Exhibit 5.

- Assume the features you rated as 4 or 5 were available today. How much would you (or your company) be willing to pay to purchase and install the equipment?

Recurring costs. Pilots were asked how much they are willing to pay as the recurring costs for the future system. The results of this part are summarized in Exhibit 6.

- Assume the features you rated as 4 or 5 were available today. How much would you (or your company) be willing to pay for annual fees of the continuous information services from the ground service provider?

Exhibit 5. Non-recurring costs for the future system.

Non-recurring costs	Percentage of entries
Less than $2,000	41.6%
More than $2,000 up to $10,000	58.4%

Exhibit 6. Recurring costs for the future system.

Non-recurring costs	Percentage of entries
Less than $500	81.5%
More than $500 up to $2,500	18.5%

Percentage of entries indicates the ratio of entries to a particular option and total number of entries to that section.

Analysis

Based on the survey results presented in the previous section, 78.4% of the participant pilots use weather radio to receive weather information. The most important difficulties they face in using this current equipment are lack of clarity and communication loss in some areas during flight. They currently receive weather updates more than every 15 minutes, which is not adequate since they would like to be informed about the weather conditions less than every 5 minutes. In summary, current weather information equipment, which is used by majority of the 139 participants, needs to be improved, or replaced by another system. This justifies the research problem.

Survey participants determine the desired characteristics of the future system. They would like to have a system with display hardware integrated into the cockpit's front panel (48.4%), or portable (35%). If the system is portable, they prefer it to be integrated into their personal palm pilot or lap top. This means that the integration of the future system into other information technologies is desired. In fact, this is usually the case when information systems such as GPS are considered (Pace et al., 1998). Participants indicated that the following features are most desirable, in their future system:

- Graphical messaging (81.3%)
- Three-dimensional terrain visualization (92%)
- LCD (86%) or color (82.6%) display
- Touch-screen data entry into the system (74%)
- Weather alert system about the conditions ahead (88.3%)
- Non-weather services are close: Aircraft performance report to the pilot with 39%, aircraft location information to the ground with 36%, and Internet access in cockpit with 27%.

As recurring costs, which are annual fees for continuing services, participants are not willing to pay more than $500. So that, independent from the non-recurring costs, which are the costs for purchasing and installing the equipment, recurring costs should be in this range to satisfy these customers.

Participants are divided almost evenly in terms of non-recurring costs as indicated in Exhibit 5. 58.4% of them are willing to pay more than $2,000 up to $10,000, while 41.6% would like to have a product for less than $2,000. This requires more analysis in order to understand the reason of this situation.

Professional affiliation of pilots might be an important parameter that affects preference of non-recurring costs. In Exhibit 7, a breakdown of non-recurring costs is shown with respect to pilots' professions. According to that, most of the private, instrument rated and commercial pilots are not willing to pay more than $2,000 for purchasing and installing the future system. This is reasonable since private and instrument rated pilots are usually not profit based, but personal interest oriented. Commercial pilots are willing to pay more than the former two since their pilot activities actually involve for-profit operations using their aircraft. Recreational pilot data does not add value to the analysis since they divide evenly between the two price ranges. Air transport pilots who are usually airline pilots are willing to pay more than $2,000. This is probably due to the fact that their companies would pay this amount.

Exhibit 7. Non-recurring costs that pilots are willing to pay (Breakdown with respect to profession).

Pilot Professions	Less than $2,000	More than $2,000 up to $10,000
Private Pilots	72.41%	27.58%
Instrument Rate Pilots	71.42%	28.57%
Commercial Pilots	60.71%	39.29%
Air Transport Pilots	33.33%	66.66%
Recreational Pilots	50%	50%

Conclusions

This study identifies the desired characteristics of the future weather information systems in GA market based on a survey.

According to the responses of the 139 GA pilots of different professional areas, current cockpit weather information systems are not adequate for pilot needs. An integrated system having a graphical, three-dimensional LCD or color display with touch-screen data entry with weather alert system, and non-weather services such as aircraft performance monitoring, and Internet access could be the answer to current difficulties and a product with a potentially large market share in GA segment. This study concludes that this product may have two non-recurring cost thresholds that would lead information system providers to produce two sets of cockpit weather information systems for each price category. In any case, recurring costs should be less than $500 for this system.

Acknowledgements

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